BRITISH WOMEN AND CHEMISTRY FROM THE 16th TO THE MID-19th CENTURY

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Introduction

We have shown elsewhere that a significant number of women chemists were active in Britain between 1880 and 1949. In fact, during that period a total of 896 women were members of the Royal Institute of Chemistry and/or the Chemical Society (1). Prior to that period, much has been published about the 17th-century chemistry researcher, Elizabeth Fulhame, author of *An Essay on Combustion* (2) and about the 18th-century chemistry popularizer, Jane Marcet (1769-1858), author of *Conversions on Chemistry* (3). Though it is certainly true that Fulhame and Marcet have exalted places in the history of women in chemistry, in our view, it is important to show that they were not the only women who developed an interest in the subject before the late 1800s. Here we will introduce some other women who had an involvement in the chemistry of their time, and then we will survey the avenues by which women of the late 18th and early 19th century could (and many did) acquaint themselves with advances in chemistry.

Mary Sydney Herbert painted by Nicholas Hilliard (ca. 1590), National Portrait Gallery painting number NPG5994 (reproduced by permission)

The Scientific Lady

The earliest recorded account of a society woman whom we could find with an interest in chemistry was Mary Sydney Herbert, Countess of Pembroke (1561-1621) (4). The Countess pursued all aspects of learning: languages, literature, poetry, music, and needlework, which were common for an intelligent aristocratic woman; more unusual were her studies of embryology, medicine, and chemistry. Herbert's biographer, John Aubrey, noted (5):

> Her Honour's genius lay as much towards chymistrie as poetrie. ... She was a great Chymist, and spent yearly a great deale in that study. ... She kept for her Laborator in the house Adrian Gilbert (vulgarly called Dr. Gilbert) halfe-brother to Sir Walter Raleigh, who was a great Chymist in those dayes.

Of course, in that period, it was more of a combination of alchemy and pharmacy than 'modern' chemistry. Unfortunately, as far as is known, Herbert did not keep a diary and thus her actual experiments are unknown. Herbert's chemical interest seems to have focused on the extrac-

tion of substances from plants by chemical procedures. This was certainly the pursuit of Lady Margaret Clifford (1540-1616), daughter of Henry Clifford, 2nd Earl of Cumberland. Her own daughter Anne recorded (6):

> She was a lover of the Study and practice of Alchimy, by which she found out excellent Medicines, that did much good to many; she delighted in the Distilling of waters, and other Chymical extractions, for she had some knowledge in most kinds of Minerals, herbs, flowers and plants.

A few years later, Dorothy Moore (c. 1612-1664) became a chemical experimenter. It was following her marriage to John Drury that she entered an intellectual circle centered around Samuel Hartlib but also involving Robert Boyle and his sister, Katherine Boyle, Lady Ranelagh (7). Moore had a particular interest in chemistry and pharmacy, and there are many references to her recipes and experiments in Hartlib's records (8). For example, Moore worked with Katherine Boyle on distillation in 1649 and with Dr. (Arnold or Gerard) Boate on "Paris chemistry" in 1654 [the Paris school, espousing modernistic chemical ideas for the time, had been founded six years earlier (9)]. Moore's extractions of essential oils from herbs and spices led her husband, Drury, to enquire from friends about the possibility of setting up a shop; but it was suggested that in view of the Drurys' position in society, private sales to a select clientele was more appropriate.

Lady Margaret Clifford

The socialite, Margaret Cavendish, Duchess of Newcastle (1624-1674), devoted many spare hours to working in the family laboratory where, among her studies across the sciences, she learned the process of chemical distillation and the dissolving power of strong acids (10). She insisted on attending demonstrations by famous scientists, such as Robert Boyle, at the most prestigious scientific institution of the day, the Royal Society (11). In fact, Cavendish was the first woman to be admitted to a meeting of the Royal Society, which she attended on May 30, 1667; but her success was a reflection of her own social position and influence rather than a breakthrough for her gender.

Margaret Cavendish

Samuel Pepys attended the meeting and took more note of her clothing than her scientific intellect (12):

> After dinner I walked to Arundell House [the Royal Society meeting place], ... where I find much company, indeed very much company, in expectation of the Duchesse of Newcastle, who had desired to be invited to the Society; and was, after much debate, pro and con, it seems many being against it; and we do believe the town will be full of ballads of it. Anon comes the Duchesse with her women attending her...The Duchesse hath been a good, comely woman; but her dress so antick, and her deportment so ordinary, that I do not like her at all, nor did I hear her say any thing that was worth hearing, but that she was full of admiration, all admiration. Several fine experiments were shown her of colours, loadstones, microscopes, and of liquors among others, of one that did, while she was there, turn a piece of roasted mutton into pure blood [by dissolution in concentrated sulfuric acid], which was very rare. ...

Over 100 years later another Duchess, Georgiana, Duchess of Devonshire, had an equal fascination for science, particularly mineralogy and chemistry. On October 23, 1793, Lady Sutherland described Georgina's routine in a letter to Lady Stafford (13):

> ... the Duke has got the gout, & the Dss is "at home" every night at 12 o'clock, afterwards she sits with him till 3. She is busy studying Chemistry, and goes out a little, she is going this morning to a chemical lecture.

Georgiana became the patron of promising scientists, including Dr. Thomas Beddoes, who is credited with the discovery of laughing gas, dinitrogen oxide.

Alic has written about the growing scientific interest by women as the 19th century progressed (14). For these upper middle class women, mathematics, biology, geology, and astronomy were relatively easy to practice for they required little in the way of facilities or expenditures. As Weldon commented in 1825, the pursuit of chemis-

try could only be accomplished by professionals and the very wealthy (15):

> [Chemistry] requires such an appropriation of time and property; such a variety of expensive and delicate instruments; such an acquisition of manual dexterity; and so much thought and attention to its successful prosecution, as will necessarily confine the *professed pursuit* of it to a few professors, and enthusiastic amateurs, whom fortune and opportunity favour.

Georgiana, Duchess of Devonshire

Elizabeth Fulhame (mid-1700s to 1800s) was the one exception. She not only practiced chemistry but also received recognition among the chemists of her time. For example, the Chemical Society of Philadelphia elected Fulhame a corresponding member (16) and, in an oration, stated that (17):

> Mrs Fulhame has now laid such bold claims to chemistry that we can no longer deny the sex the privilege of participating in this science also.

Though little is known about Fulhame's life, Fulhame had an advantage that her husband, Thomas Fulhame, was an affluent physician and that she was acquainted with some of the scientists of the time, such as chemist Joseph Priestley (18). In addition, a quote in the preface of her book suggests that she was goaded into commencing experimentation (19):

> The possibility of making cloths of gold, silver, and other metals by chymical processes, occurred to me in the year 1780; the project being mentioned to Doctor Fulhame and some friends, was deemed improbable. However, after some time, I had the satisfaction of realizing the idea in some degree by experiment.

The lack of chemical laboratory facilities is probably why Mary Somerville (1780-1872), hailed at her death as "The Queen of Nineteenth Century Science," contributed little to chemistry (20). Her sole venture, performed in collaboration with Michael Faraday, was a study of light absorption by different materials using the degree of darkening of silver chloride (21).

Public Lectures

Even if women (with very few exceptions, such as Fulhame) were unable to practice chemistry, they were eager to learn about it, and the 'scientific lady' became an accepted term in the vocabulary of the time (22). Higgitt and Withers have extensively reviewed the participation of women at the British Association for the Advancement of Science (BAAS) meetings (23). The BAAS meetings had a dual role of professional discourse and of popularization of scientific discoveries, two very dissimilar and often conflicting objectives. At first women were allowed to attend only the social functions, though the scientific interest of some of the women became apparent at the 1831 meeting at York, when the *Yorkshire Gazette* reported that there was "... an *elementary* lecture on magnetising at which there were present perhaps not less than a hundred fashionable ladies!!" (24). There was much concern among the organizers of the Oxford meeting the following year that Mary Somerville would attend (25). Fortunately for them, she did not, relieving them of the anxiety of what to do with a woman who was also a *bona fide* scientist.

Women were first formally admitted into the geology and botany sections in 1837 and then into other sections, including chemistry, by 1838 (23). However, admission was subject to the availability of space in the galleries and in women-only parts of the rooms. At the Newcastle meeting held that year, of the 3,530 attendees, 1,100 were 'ladies.' A very high proportion of the women were wives or daughters of scientists and they were at the meeting ostensibly for the social events; nevertheless, many women did attend and enjoy the sessions.

The most important venue for women to learn about chemistry was the Royal Institution (RI). Though the first public lecture at the RI took place in 1800, it was Humphry Davy's charismatic chemistry lectures during the 1802-1812 period that brought the affluent to the institution's premises on Albemarle Street (26). Notably, about half the audience was made up of women, which pleased Davy. However, Davy believed that women should absorb scientific knowledge and transmit it to their offspring but certainly not practice science (27).

There are several accounts of the audience reactions at these lectures (26), but unfortunately none is by a woman. What is particularly interesting in all

these reports is the gender difference in attitude: the males feigning boredom, while the women were assiduously paying attention and often note-taking. Among the several accounts of this difference was that of Robert Southey (1774-1833). Southey, an English poet, wrote in 1807 an extremely penetrating and accurate account of English life of the period, including a description of a Royal Institution lecture (28):

> Part of the men were taking snuff to keep their eyes open, others more honestly asleep, while the ladies were all upon the watch, and some score of them had their tablets and pencils, busily noting down what they heard, as topics for the next conversation party.

The apparent boredom of the male audience during such fascinating presentations seems paradoxical. However, Myers (29) has offered an explanation in terms of public lectures as being seen as the trivialization of science at which the gentlemen had either to pretend that chemistry did not count as worthwhile knowledge or that the chemistry was already familiar to them. For ladies to find the knowledge so gripping and noteworthy only further trivialized the subject. From the perspective of this work, however, it is the obvious interest of the women in chemistry that is striking.

Caroline Fox

One of the women who attended a lecture at the Royal Institution during the time of Davy's successor, Michael Faraday, was Caroline Fox (1819-1871). Daughter of the amateur scientist Robert Were Fox, she kept a journal from 1835 until shortly before her death. She grew up in a household surrounded by her father's science as her mother's relative, Mary Anne Schimmelpenninck, commented (30):

> Imagine the back drawing-room strewn with reflectors, and magnets, and specimens of iron, and borax, cobalt, copper ore, blow-pipes, platina, &c., &c.; deflagrations, fusions, and detonations on every side; whilst we were deeply interested in watching the fusions of the ores, or their assaying; only that now and then I, having a house of my own, had a fellow feeling with Maria [wife of Robert Fox], at seeing a certain beautiful zebra-wood table splashed with melted lead or silver, and the chased Bury Hill candlestick deluged with acids.

According to her journal, Caroline Fox attended many of the BAAS meetings. In addition, she visited the Royal Institution on June 13, 1851 to watch Faraday's chemical experiments. She reported (31):

> We went to Faraday's Lecture on "Ozone." He tried the various methods of making Ozone which Schönbein has already performed in the kitchen, and he did them brilliantly. He was entirely at his ease, both with his audience and his chemical apparatus; he spoke much and well of Schönbein, who now doubts whether Ozone is an element, and is disposed to view it simply as a condition of oxygen, in which Faraday apparently agrees with him.

It was not only London women who were intrigued by chemistry. At the University of Edinburgh, Thomas Charles Hope, Lecturer in Chemistry, introduced in 1826 "A Short Course of [Chemistry] Lectures for Ladies and Gentlemen" (32). The presence of women on campus was not appreciated by many academics; for example, Lord Cockburn wrote to a T. F. Kennedy (33):

> The fashionable place here now is the College; where Dr Thomas Charles Hope lectures to ladies on Chemistry. He receives 300 of them by a back window, which he has converted into a door. Each of them brings a beau, and the ladies declare that there was never anything so delightful as these chemical flirtations.

Printed Resources

In addition to scientific lectures for women, some women's magazines in the 18th and early 19th centuries carried articles on science (34). There were three short-lived women's magazines in the early 18th century that contained scientific essays (22a): *The Female Spectator* (1744-1746) and *Epistles for the Ladies* (1749-1750), both edited by Eliza Haywood, and then *The Lady's Museum* (1760-1761) by Charlotte Lennox. Longer surviving was *The Ladies' Diary: or, The Woman's Almanack, Containing many Delightful and Entertaining Particulars, Peculiarly Adapted for the Use and Diversion of the Fair-Sex* (1704-1840), which focused on science, philosophy, and mathematics (35).

Shteir (36) has examined three other journals: the *Lady's Magazine* (1770-1832); the *Lady's Monthly Museum* (1798-1828), and the first volume of the *Lady's Companion at Home and Abroad* (1849-50). At the beginning of the 19th century, the *Lady's Magazine*

frequently carried articles on science, as Shteir noted (37):

> For a short time, the *Lady's Magazine* included scientific excerpts drawn from contemporary publications, such as an essay on the "Progress and Utility of Chemistry" from the recently founded *Quarterly Journal of Science* and a portion of Sir Humphrey Davy's 1821 address to the Royal Society on "the present State of Science."

However, the ownership of the magazine changed in 1822, and the new editor eschewed "the abstruse mysteries and tedious details of science." When the topic of science for ladies was discussed in 1831, botany was considered the most suitable because (37):

> …ladies will not, in pursuing botany, have to discolour their fingers in trying chemical experiments on substances which they may have previously risked their necks to obtain.

The first editor of the *Lady's Companion at Home and Abroad* was Jane Loudon, who believed her task was to educate her readers and provide mental stimulation – or 'mental cultivation' as she called it. Included in this goal was a steady stream of scientific articles. Again, quoting Shteir (38):

> In 1850 one of the male contributors presented a series of articles about fermentation and combustion under the title 'Chemistry and Everyday Life.' Edward Solly, a teacher and lecturer on chemistry who was associated with the Royal Institution and the Horticultural Society, joined Loudon's crusade to bring science into general female education. Applauding the increased 'desire for knowledge,' he celebrated the importance of the sciences.

After Loudon gave up her position as editor in June, 1850, the direction of the magazine changed dramatically. When a long-standing subscriber expressed her dismay that drawings of flowers were now ornamental rather than botanical, the new (male) editor expressed his opinion that the designs of bonnets and sleeves were more important for women's minds than the mysteries of the botanical world.

Books were the primary means for women to learn about science (39), for writing about science enabled women to participate in the scientific enterprise without violating gender norms (40). The first book on chemistry specifically for women was *La Chymie charitable et facile, en faveur des dames*, authored in France by Marie Meudrac in 1666 (41). This was sufficiently popular that it was reprinted in 1674 and again in 1711. However, for British women, it was through Jane Marcet`s book, *Conversations on Chemistry: in which the Elements of that Science are familiarly explained and illustrated by Experiments* (42), that they were able to comprehend the mysteries of chemistry and, from edition to edition, keep up with the latest discoveries (43).

Marcet had developed an interest in chemistry by attending some of Davy's early lecture-demonstrations at the Royal Institution. Finding them confusing, she decided to write a fictional account of a discourse on chemistry between a teacher, Mrs. B, and two students, Emily and Caroline. Initially for her own understanding, the book was first published in 1806. Marcet considered the conversational style particularly appropriate to women readers (44):

> Hence it was natural to infer, that familiar conversation was, in studies of this kind, a most useful auxiliary source of information; and more especially for the female sex, whose education is seldom calculated to prepare their minds for abstract ideas, or scientific language.

In addition, as Myers has discussed, Marcet's adaptation of chemical discovery to a work of fiction set in a country house gave women readers a sense that chemistry was also part of their own world (29).

Marcet's book was read by at least three well-known women of the time. Helen Hamilton Douglas (c.1768-1837), wife of the Scottish geologist and chemist, Sir James Hall Douglas, wrote to Jane Marcet explaining her reasons for reading *Conversations on Chemistry* (45):

> I was at that time keen to improve myself by reading and attending lectures, keen to acquire knowledge, for the pleasure of conversing with my husband and communicating instruction to my young family.

A reader of the French translation of *Conversations on Chemistry* was Anne Louise Germaine Necker, Madame de Staël (1766-1816). Necker wrote to Jane Marcet's husband, Alexander Marcet (46), "I have proposed the study of chemistry in the dialogues of Mrs. Marcet ... the beginning [is] most clever and the work admirably clear."

The novelist Maria Edgeworth (1767-1849) also read *Conversations on Chemistry* (47). In fact, her chemical knowledge, acquired by reading Marcet's book, possibly saved the life of Edgeworth's younger sister. The sister had swallowed acid and Maria recalled from the text that milk of magnesia was an effective antidote. Following the incident, Edgeworth wrote of the benefits for women of studying chemistry (48):

> ... chemistry is a science particularly suited to women, suited to their talents and to their situation. Chemistry is not a science of parade, it affords occupation and infinite variety, it demands no bodily strength, it can be pursued in retirement, ... there is no danger of its inflaming the imagination; ... [because] the mind is intent upon realities, the knowledge that is acquired is exact; and the pleasure of the pursuit is a sufficient reward for the labour.

Commentary

In this account, we have endeavored to show that there have been British women interested in, and involved in, the chemical scene at least since the late 1500s. Unfortunately, we will never know the full extent of this involvement as women's history in this context is so fragmented. Likewise, we are unlikely to learn much more about the hundreds who viewed chemistry from the sidelines at the Royal Institution lectures or the thousands who purchased a copy of Marcet's book.

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